

Multi-Hazard Environmental Impact Detection System

Feature Expansion, Evaluation & Test Specification

1. Project Overview

This document defines the extended functional scope, feature roadmap, testing strategy, and evaluation plan for a satellite-based multi-hazard environmental impact detection system. The system builds upon existing wildfire and drought detection capabilities and expands into rainfall, vegetation health, and composite environmental impact assessment.

2. Core Functional Requirements

The system shall support wildfire burnt-area mapping, drought stress detection, rainfall impact analysis, vegetation health monitoring, and unified impact scoring using satellite imagery and auxiliary datasets.

3. Wildfire Detection Module

Detects burnt and unburnt regions using bi-temporal satellite images. Outputs include binary masks, probability maps, burnt-area statistics, and burn severity classification.

4. Drought Detection Module

Analyzes vegetation stress patterns over time using spectral degradation indicators. Provides drought masks, severity scores, and regional statistics.

5. Rainfall Impact Analysis Module

Integrates external rainfall datasets with satellite imagery to quantify rainfall anomalies and correlate precipitation trends with environmental changes.

6. Vegetation Health Monitoring

Computes vegetation indices such as NDVI, NBR, and NDWI to assess ecosystem health and detect long-term environmental degradation.

7. Data Processing Pipeline

Includes satellite preprocessing, band normalization, tiling, alignment validation, and feature extraction for downstream analysis.

8. Multi-Factor Impact Scoring Engine

Aggregates outputs from all hazard modules into a unified impact index representing overall environmental risk.

9. Visualization & Reporting

Provides interactive dashboards, layered map visualizations, and automated PDF/JSON report generation.

10. Testing Strategy

Defines unit tests, integration tests, performance benchmarks, and edge-case validation for all system modules.

11. Performance Metrics

Key metrics include IoU, F1-score, inference latency, scalability benchmarks, and robustness evaluations.

12. Future Extensions

Planned extensions include flood detection, landslide susceptibility analysis, carbon loss estimation, and time-series forecasting.